Title: Sports Statistics in the Classroom

Brief Overview:

Many people are fascinated with sports statistics. Many times, their fascination ranges among the way football experts rate quarterbacks to the way players and teams are compared to each other. In this unit, students will compute/compile many of the statistics they see in their local newspapers and on Internet websites. They will then use descriptive/comparative statistics to compare players and teams based on the statistics they computed/compiled earlier. Hopefully, students will gain a better understanding of everyday sports statistics and their real-world applications, as well as a greater appreciation for statistics.

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**
  These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize the need to help students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

- **Number and Operation**
  Among other things, students will compute quarterback ratings [in football], slugging percentage [in baseball], and field goal accuracy [in basketball] using formulas in which they will have to use order of operations.

- **Data Analysis, Statistics, and Probability**
  Students will use descriptive and comparative elementary statistics to compare football, baseball, and basketball players' statistics [as well as team statistics] to each other.

Links to Virginia High School Mathematics Core Learning Units:

- **A.18**
  Students will compare multiple one-variable data sets, using statistical techniques that include measures of central tendency, range, stem-and-leaf plots, and box-and-whisker graphs.

- **AII.19**
  Students will collect and analyze data to make predictions, write equations, and solve practical problems. Graphing calculators will be used to investigate scatter plots to determine the equation for a curve of best fit.

Grade/Level:

Grades 9-12; Algebra II, Computer Technology, and Statistics

Duration/Length:

This lesson should take about 2 90-minute block periods, possibly 3 to 4 50-minute class periods.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Order of operations
- Calculating measures of central tendency [mean, median, etc…]
- Knowledge of box-and-whisker graphs, stem-and-leaf plots, and/or histograms
- Comparing data with 1- or 2- sample t-tests [or proportion tests]
- Use of the Internet

Objectives:

Students will:

- collect, compile, and analyze data [sports statistics] collected from the Internet.
- construct descriptive representations of the sports statistics that they are comparing.
- use statistical tests to analyze the sports statistics that they are comparing.
- interpret their descriptive/comparative statistics to draw conclusions, and later, discuss their findings appropriately.

Materials/Resources/Printed Materials:

- Computer with Internet access
- Worksheets provided with this lesson
- Pencil and graph paper
- Graphing Calculator

Development/Procedures:

Teachers will provide their students with computers [that have Internet access] and the lesson worksheets. Teachers should work out all of the statistics and have a grounded understanding of the topics discussed. The students will struggle with some of the predictions they will have to make, but allow them to talk and debate among themselves to better understand the topic. The instructor will then act as a facilitator who will assist students when they require help. It is highly recommended that students work in groups of two or three.

It also may be beneficial to have the students work at their seats and do practice problems to understand the computation before the group and the computer work.

Assessment:

There is plenty of flexibility with this assignment and its assessment. Teachers can either have students work individually or in pairs on this lesson. [Note: Working in pairs is highly recommended for Algebra II students]. Teachers can then grade this as class-work, a quiz, a small project, or even extra-credit. Furthermore, they could include the concepts from this lesson on an upcoming quiz or test.

Extension/Follow Up:

As a follow-up, students can collect their own data from the Internet, compile statistics, and then use descriptive/comparative methods to analyze their own data. They can then state their own conclusions and discuss their results.

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Introduction: This project can be treated as a week-long unit or developed into a three part lesson spread out throughout the year introducing each sports statistic when that sport’s season begins. The “Quarterback Rating” will be the first of the three. This can be introduced at the beginning of the school year. One method may be to look at the statistics of a local pro or high school football team. Talk about the team and its performance. Talk about the quarterback. Compare the quarterback’s data with one of his peers. Without statistical analysis, make a prediction on who is/was the better quarterback. Ask the students what statistics could be compared to determine the better quarterback. Each section starts with a worksheet to pass out to students and then teacher notes to assist instructors in applying the statistics given.

The Quarterback Rating

The Quarterback Rating was a statistic designed to incorporate all of a quarterback's statistical performances and calculate it into one rating. The rating is a very complicated formula that will test your knowledge of the correct order of operations. The actual formula seems to have no rhyme or reason, but the calculations show a trend that a score of 100 is a very good score. This is probably what the creator of this formula was looking for. There are also limitations to each of the "inner ratings". Please take note of this.

The Calculation of the Quarterback Rating

The Quarterback Rating is made up of 4 "inner ratings." These need to be calculated first to obtain the Quarterback Rating. Please note the parenthesis; even with a graphing calculator simple mistakes can be made.

The Inner Ratings:

- Completion % Rating → CR = 5 * [(Comp / Att) – 0.3]

- Touchdown % Rating → TR = 19.958 * (TD / Att)

- Interception % Rating → IR = 2.375 – [25 * (Int / Att)]

- YPA Rating → YR = 0.25 * [(Yds / Att) – 3]
  NOTE: YPA is the yards per attempt.

QB Rating = [CR + TR + IR + YR] / 0.06

Note: All "inner ratings" must fall between 0 and 2.375.
For example, if the CR value is 3.212 the value will default to 2.375; (0 < CR < 2.375)
A Work in Progress: Here is a listing of how some prominent NFL Quarterbacks have done in their second year as a regular starter:

Name	*Season*	*Team*	*Att*	*Comp*	*Yards*	*TD's*	*Int's*
Troy Aikman	1990	Cowboys	399	226	2579	11	18
*Bubby Brister	1989	Steelers	342	187	2365	9	10
*Randall Cunningham	1987	Eagles	406	223	2786	23	12
Brett Favre	1993	Packers	522	318	3303	19	24
*Brad Johnson	1997	Vikings	452	275	3036	20	12
# Dan Marino	1984	Dolphins	564	362	5084	48	17
$ Joe Montana	1981	49ers	488	311	3565	19	12
*Neil O'Donnell	1992	Steelers	313	185	2283	13	9
Kordell Stewart	1998	Steelers	458	252	2560	11	18
*Steve Young	1991	49ers	279	180	2517	17	8

KEY: * Earned a playoff spot; # Played in the Super Bowl; $ Won the Super Bowl

Name	Season	Team	Att	Comp	Yards	TD's	Int's	CR	TR	IR	YR	QB Rating
# Dan Marino	1984	Dolphins	564	362	5084	48	17	1.709	1.699	1.621	1.504	**108.88**
*Steve Young	1991	49ers	279	180	2517	17	8	1.726	1.216	1.658	1.505	**101.76**
$ Joe Montana	1981	49ers	488	311	3565	19	12	1.686	0.777	1.760	1.076	**88.34**
*Brad Johnson	1997	Vikings	452	275	3036	20	12	1.542	0.883	1.711	0.929	**84.43**
*Neil O'Donnell	1992	Steelers	313	185	2283	13	9	1.455	0.829	1.656	1.073	**83.56**
*R Cunningham	1987	Eagles	406	223	2786	23	12	1.246	1.131	1.636	0.966	**82.98**
*Bubby Brister	1989	Steelers	342	187	2365	9	10	1.234	0.525	1.644	0.979	**73.03**
Brett Favre	1993	Packers	522	318	3303	19	24	1.546	0.726	1.226	0.832	**72.16**
Troy Aikman	1990	Cowboys	399	226	2579	11	18	1.332	0.550	1.247	0.866	**66.59**
Kordell Stewart	1998	Steelers	458	252	2560	11	18	1.251	0.479	1.392	0.647	**62.84**

Part I: Statistical Computation

1. Given the formula for determining quarterback ratings, compute the ratings for the quarterbacks listed above. Use your graphing calculators. You may write a program on your calculator if you wish. Remember order of operations and feel free to use the parentheses and brackets on your calculator.

2. Check your results with your teacher. [teachers can now provide students with easy calculator for QB ratings or the table *with* all the ratings].

3. If Dan Marino threw 20 less completions in the same amount of attempts, yet threw 2 more touchdowns, would that be the same as throwing 20 more completions in the same amount of attempts with 2 more interceptions? Calculate and discuss the separate weights involved in the formula.

4. Calculate the lowest and highest quarterback ratings possible. For example: Suppose a quarterback completes 2 out of 10 passes with 2 interceptions for 12 yards and 0 touchdowns. Is that the worst a quarterback could possibly play (remember the values for each "inner value" must be: 0 < value < 2.375?

Part II: Descriptive Statistics and Prediction

5. Sketch a bar graph of all the above quarterbacks and their ratings. Names on the x-axis, ratings on the y-axis. Discuss.

6. Compare Steve Young (http://www.nfl.com/players/profile/3369.html) {you must click on the statistics link below NFL experience to find this data} and Dan Marino's (http://www.nfl.com/players/profile/2375.html) career quarterback ratings, for *each year*, with comparative boxplots. Use the following hyperlink and copy the results on your graph paper. Follow the directions carefully at the following website to do your boxplots correctly. (http://www.stat.ucla.edu/calculators/boxplot.phtml) Discuss your findings in the boxplots.

7. Compare Brett Favre (http://www.nfl.com/players/profile/1692.html) to Troy Aikman's (http://www.nfl.com/players/profile/1015.html) *year-by-year* touchdown passes with stem-and-leaf plots (http://patriot.cofc.edu/stats/stats.html) Discuss. Find the five number summaries on each quarterback's touchdown passes, using the same link right above. Which is the best measure of central tendency in each case? Mean or Median? Discuss.

8. Let's assume that the distribution of the top 30 quarterback ratings (http://stats.nfl.com/stats/stats.asp) [note: you will have to choose passing from 1998 through week 17 to see all quarterbacks and their ratings] is normally distributed. Verify this by either sketching a histogram, boxplot, or stemplot. (http://www.stat.ucla.edu/calculators/boxplot.phtml) or (http://patriot.cofc.edu/stats/stats.html) Find the measures of central tendency [mean, median, standard deviation, etc..]. Then, assuming that the ratings are normally distributed, find the probability of: (a) having a QB rating of 90 or higher , (b) having a QB rating of 50 or lower, and (c) having a QB rating between 75 and 90. [hyperlinks]

9. Let's now take a look at the above chart and each quarterback's number of completions as it relates to the number of yards they threw for.

- What kind of relationship is this? Discuss.
- Do a least-squares linear regression on these two variables and find the line of best fit. (http://bardeen.physics.csbsju.edu/stats/QFnP_NROW_form.html) Draw the scatter plot and line of best fit on your graph paper along with the equation of best-fit. Be careful in following directions at the above site.

- You can also have the computer plot the scatter plot, and label the axes, by following the directions at the above site. Otherwise, plot the points on paper and draw the line of best-fit.
- Is there a linear relationship here?
- Can you think of other linear relationships that you could analyze with the chart above? List 2 examples.
- Using the line of best fit (from least-squares regression scatter plot), predict the number of yards that Drew Bledsoe should have thrown for in his 2nd year as a starter, given that he had completed 400 passes. Drew Bledsoe (http://www.nfl.com/players/head/1201.html) actually threw for 4555 yards in his 2nd season as an NFL starting quarterback. How far off was your prediction, using the predicted line of best fit?
- Steve McNair (http://www.nfl.com/players/head/2469.html) threw for 2665 yards in his 2nd full season as an NFL starting quarterback. Use your line of best fit to predict the number of completions he actually had in his 2nd season. Steve McNair actually threw for 216 completions. How far off was your prediction using the predicted line of best fit?
- Is a linear model a good predictor for variables such as these? Discuss.

Part III: Statistical Testing [Making comparisons with t-tests]

Introduction: There are many different tests and comparisons that we can run to find out more about certain players and/or teams. For example, we could compare different quarterbacks to determine whom, on average, throws the most number of touchdown passes. In the example below, we will compare: [Be sure to click "statistics" under each player's picture.

Warren Moon http://www.nfl.com/players/profile/2538.html
Dan Marino http://www.nfl.com/players/profile/2375.html
Troy Aikman http://www.nfl.com/players/profile/1015.html

Example:
Let's assume that we don't know anything about these 3 quarterbacks and the amount of touchdowns they have thrown throughout their careers. So without this knowledge, we cannot assume that any of the 3 quarterbacks throws any more touchdown passes than the others do. Most null hypotheses [in elementary statistics] work this way. Therefore, our null hypotheses when comparing quarterbacks in pairs should be either:

Ho: Marino [TDs] = Moon [TDs]
Ho: Moon [TDs] = Aikman [TDs]
Ho: Marino [TDs] = Aikman [TDs]

Note: There is a way to compare all 3 quarterbacks in one null hypothesis statement using analysis of variance methods [ANOVA]. For the purposes of this lesson, we will only make comparisons 1 pair at a time using t-tests.
Now let's start with the first comparison.

Ho: Marino [TDs] = Moon [TDs]

Let's now predict that Marino throws more touchdowns than Moon does. We can predict the opposite if we wish, but for now let's just predict that Marino is the more proficient TD passer. Since that is the case here, our alternative hypothesis would be:

Ha: Marino [TDs] > Moon [TDs].

Therefore, we now have:
Ho: Marino [TDs] = Moon [TDs]
Ha: Marino [TDs] > Moon [TDs]

To test this assumption, we now have to run a 2-sample t-test. Simply enter the TDs from *each year* for each quarterback [hyperlinks to Marino and Moon and you must click on statistics under each player's picture] into the 2 lists at:
http://fig.cox.miami.edu/~burgess/Students_t.html
and *carefully* read the instructions. After running the test, you should notice that Marino averages 25.5 touchdowns per year, with a variance of 95.2. By taking the square root of variance, we get the standard deviation, which is about 9.8. Moon's average TD tosses are 19.3, variance = 55.8, or standard deviation = 7.5. One thing to note, if graphed, is that neither distribution is normally distributed. And they do not necessarily have to be. Notice that the 1-tailed p-value [probability value] is 0.0295. This probability value is very small [less than 3 percent]. Normally, our cut-off level of significance is 5 percent. Since this probability value is lower than 5%, we reject the null hypothesis and accept the alternative hypothesis. Therefore, according to our test, Marino throws more touchdowns than Moon on average.

If on the other hand, we ran a 2-tailed test, our alternative hypothesis would have been, Ha: Marino [not equal to] Moon, and our p-value would have been twice the 1-tailed value, or 2 times 0.0295 = 0.059. Since this p-value is slightly more than 5 percent, we might be inclined to "fail to reject the null hypothesis" and conclude that there is no significant difference with the 2-tailed test. But this p-value is still pretty close to 5%, which is an arbitrary cut-off value. If our cut-off was 2%, we would reject the null hypothesis in both cases and conclude that the two quarterback's touchdown averages are not equal, or that Marino's is more than Moon's. In this respect, both tests would yield approximately the same result.

Easy, huh? Think about those results. Marino throws 25.5 touchdowns on average each season compared to Moon's 19.3 per season. It should be obvious that Marino is the more proficient touchdown thrower. What we just proved *statistically* is that Marino is *significantly* better than Moon. Now it's YOUR turn.

10. Compare Moon's touchdown passes to Aikman's [hyperlinks] using the same procedure we used above. Write down the null hypothesis and alternative hypothesis [Moon TDs greater than Aikman].

Ho: Moon = Aikman
Ha: Moon > Aikman

Run the test using each player's data at the links above, and be sure to click on "statistics" under each player's name. To run the test, again refer to:

http://fig.cox.miami.edu/~burgess/Students_t.html

Write down the mean and standard deviation for each player along with the p-value. State your conclusions and discuss your results the same way we did in the example above. You should look at the mean TD passes thrown by each player. Are they different? Without testing anything at all, wouldn't you say that Moon was the better TD passer? Did your t-test confirm this, or in other words, is Moon *significantly* better than Aikman?

11. Now that you know Marino throws more TDs than Moon, and Moon throws more TDs than Aikman, could you predict the more proficient TD passer between Marino and Aikman? Test your predictions by stating the null and alternative hypotheses along with the means, standard deviations, and p-values. State your conclusion and discuss your results.

12. Use a 2-sample t-test, like the ones above, to compare Marino's yearly quarterback ratings with Aikman's. Do everything the same way as in numbers 10 and 11 above, state your conclusions, and discuss your results. Who's the better quarterback in your opinion? Should it matter that Aikman has won 3 championships while Marino hasn't won any? Discuss.

Extension/Bonus:

13. Compare anything you wish [in any sport] with a 2-sample t-test and write up everything the same way as in numbers 10-12 above.

Baseball

Baseball, America's pastime... Throughout the 20th Century, our country has experienced a great deal of change. Wars, technology and time have shaped our country into a much different place since the early 1900's. There is one constant though, baseball. The game still has the same core of principals since the first World Series was played. For statisticians and mathematicians, this provides a great data source in which to compare players throughout the decades. You will be faced with different terminology and complicated places to research these statistics. By the end of this exercise, you will be able to understand all of the terminology and ways to calculate a special statistic.

Slugging Percentage

Baseball Players can be compared in many different ways. One of the most exciting aspects of the game of baseball is the homerun. The homerun chase of 1998 was one of the most exciting memories of recent history. Even though homeruns are very exciting, they are not the best way to judge a batter's power at the plate. This statistic is called the slugging percentage. The slugging percentage incorporates homeruns, but also includes triples (3B), doubles (2B), and singles.

$$\text{SLUGGING PERCENTAGE} = \frac{\text{Total Number of Bases}}{\text{At Bats}}$$

Total Number of Bases = (singles value) + (2B value) + (3B value) + (HR value)

Singles Value = (# of singles) * 1
Doubles Value = (# of 2B) * 2
Triples Value = (# of 3B) * 3
Homerun Value = (# of HR) * 4
# of singles = H – (2B + 3B + HR)

Career Statistics

Name	G	AB	R	H	2B	3B	HR	RBI	BB	K
Hank Aaron	3298	12364	2174	3771	624	98	755	2297	1402	1383
Barry Bonds	1898	6621	1364	1917	403	63	411	1216	1357	1050
Roberto Clemente	2433	9454	1416	3000	440	166	240	1305	NA	NA
Joe DiMaggio	1736	6821	1390	2214	389	131	361	1537	790	369
Ken Griffey Jr.	1375	5526	940	1569	294	27	350	1018	656	876
Mickey Mantle	2401	8102	1677	2415	344	72	536	1509	1734	1710
Mark McGwire	1535	5131	941	1353	219	5	457	1130	1052	1259
Babe Ruth	2503	8399	2174	2873	506	136	714	2213	2056	1330

Key: G-Games ; AB-At Bats ; R-Runs ; H-Hits ; 2B-Doubles ; 3B-Triples
HR- Homeruns ; RBI-Runs Batted In ; BB-Walks ; K-Strikeout (sometimes SO)

Teacher Notes for Baseball Sheet

Have students calculate the slugging percentage of each player by using a spreadsheet and entering their own calculations.

Name	*G*	*AB*	*R*	*H*	*2B*	*3B*	*HR*	*RBI*	*BB*	*K*	*Singles Value*	*2B Value*	*3B Value*	*HR Value*	*Slugging%*
Babe Ruth	2503	8399	2174	2873	506	136	714	2213	2056	1330	1517	1012	408	2856	**0.690**
Joe DiMaggio	1736	6821	1390	2214	389	131	361	1537	790	369	1333	778	393	1444	**0.579**
Mark McGwire	1535	5131	941	1353	219	5	457	1130	1052	1259	672	438	15	1828	**0.576**
Mickey Mantle	2401	8102	1677	2415	344	72	536	1509	1734	1710	1463	688	216	2144	**0.557**
Barry Bonds	1898	6621	1364	1917	403	63	411	1216	1357	1050	1040	806	189	1644	**0.556**
Hank Aaron	3298	12364	2174	3771	624	98	755	2297	1402	1383	2294	1248	294	3020	**0.555**
Ken Griffey Jr.	1375	5526	940	1569	294	27	350	1018	656	876	898	588	81	1400	**0.537**
Roberto Clemente	2433	9454	1416	3000	440	166	240	1305	NA	NA	2154	880	498	960	**0.475**

The chart above is the sorted calculation sheet for the slugging percentage calculations.

Many questions can lead from these original calculations.

Here are some examples:

1.) Given all the players given, who is the best hitter?

Answer: Calculate the batting average (H/AB).

Name	*G*	*AB*	*R*	*H*	*2B*	*3B*	*HR*	*RBI*	*BB*	*K*	*Batting Ave*
Babe Ruth	2503	8399	2174	2873	506	136	714	2213	2056	1330	**0.342**
Joe DiMaggio	1736	6821	1390	2214	389	131	361	1537	790	369	**0.325**
Roberto Clemente	2433	9454	1416	3000	440	166	240	1305	NA	NA	**0.317**
Hank Aaron	3298	12364	2174	3771	624	98	755	2297	1402	1383	**0.305**
Mickey Mantle	2401	8102	1677	2415	344	72	536	1509	1734	1710	**0.298**
Barry Bonds	1898	6621	1364	1917	403	63	411	1216	1357	1050	**0.290**
Ken Griffey Jr.	1375	5526	940	1569	294	27	350	1018	656	876	**0.284**
Mark McGwire	1535	5131	941	1353	219	5	457	1130	1052	1259	**0.264**

2.) Look at Babe Ruth's triples. How can a man who was so overweight have so many triples?

Answer: (1) Ruth wasn't always so overweight, and (2) the ballparks were much larger than today's ballfields. Check Honus Wagner's and Ty Cobb's statistics for validation.

3.) Of the given players, who was the one who swung for the fences the most?

Answer: Look at the ratio between K to AB (disregard Clemente):

Name	*G*	*AB*	*R*	*H*	*2B*	*3B*	*HR*	*RBI*	*BB*	*SO*	*K%*
Mark McGwire	1535	5131	941	1353	219	5	457	1130	1052	1259	**24.5%**
Mickey Mantle	2401	8102	1677	2415	344	72	536	1509	1734	1710	**21.1%**
Barry Bonds	1898	6621	1364	1917	403	63	411	1216	1357	1050	**15.9%**
Ken Griffey Jr.	1375	5526	940	1569	294	27	350	1018	656	876	**15.9%**
Babe Ruth	2503	8399	2174	2873	506	136	714	2213	2056	1330	**15.8%**
Hank Aaron	3298	12364	2174	3771	624	98	755	2297	1402	1383	**11.2%**
Joe DiMaggio	1736	6821	1390	2214	389	131	361	1537	790	369	**5.4%**

Use the Quarterback Rating Model to create any additional statistical analysis questions, such as:

Compare Ruth's year-by-year home run totals to Mark McGwire's. Use a 2-sample t-test. First, compare visually with a stem-leaf plot or boxplot. Write conclusions. Discuss. Students should be able to find the statistics for both players on the Internet. Stem-leaf plots, boxplots, t-tests, html addresses are in the QB-rating section.

Basketball

Showtime baby! The dash and flash of sport has culminated within the basketball game that we know today. Crossover dribbles, tomahawk slams, and ali-oops have now become the staple of the game. Players cannot be measured on their cornrows or their new tattoos, but they all have something still in common, they can shoot the ball. You will examine a handful of past and prior players and use a new statistic that we created that will incorporate field goal % (FG%), the percentage of shots made anywhere on the floor during play and free throw % (FT%), the percentage of shots made from the free throw line.

True Shooting Percentage

The true shooting % (TS%) will be an average of the FG% and their FT%.

$$TS\% = \frac{FG\% + FT\%}{2}$$

Note: The percentages must be converted into decimals for calculation.

Career Statistics

Name	***FG%***	***FT%***	***PPG***
Charles Barkley (4)	54.4%	73.6%	22.5
Larry Bird (3/4)	49.6%	88.6%	24.3
Wilt Chamberlin (5)	54.1%	51.1%	30.1
Tim Duncan (4/5)	54.9%	66.2%	21.1
Grant Hill (3)	47.1%	73.4%	20.7
Allen Iverson (1/2)	43.8%	71.5%	22.7
Magic Johnson (1/2/3)	52.1%	84.8%	19.7
Michael Jordan (2/3)	50.5%	83.8%	31.5
Reggie Miller (2)	48.5%	87.7%	19.7
Shaquille O'Neal (5)	57.8%	53.5%	27.2
Scottie Pippen (3/4)	48.3%	69.3%	18.0

Note: PPG is the points per game. This is the total amount of points a player scores in a game averaged over a full season or career.

The numbers that appear after the player's name denote the player's position(s):
1- point guard
2- shooting guard
3- small forward
4- power forward
5- center

Generally, the (1) and (2) positions play and shoot farther away from the basket, the (3) and (4) positions shoot from various positions (far and close to the basket), and the (5) position players are usually very close to the basket.

Teacher Notes for Basketball Sheet

(These sheets may be used as student worksheets.)

1a.) Have students calculate the True Shooting Percentage:

Answer:

Name	*FG%*	*FT%*	*PPG*	*TS%*
Larry Bird (3/4)	49.6%	88.6%	24.3	69.1%
Magic Johnson (1/2/3)	52.1%	84.8%	19.7	68.5%
Reggie Miller (2)	48.5%	87.7%	19.7	68.1%
Michael Jordan (2/3)	50.5%	83.8%	31.5	67.2%
Charles Barkley (4)	54.4%	73.6%	22.5	64.0%
Tim Duncan (4/5)	54.9%	66.2%	21.1	60.6%
Grant Hill (3)	47.1%	73.4%	20.7	60.3%
Scottie Pippen (3/4)	48.3%	69.3%	18.0	58.8%
Allen Iverson (1/2)	43.8%	71.5%	22.7	57.7%
Shaquille O'Neal (5)	57.8%	53.5%	27.2	55.7%
Wilt Chamberlin (5)	54.1%	51.1%	30.1	52.6%

This chart is sorted from best to worst true shooters. To sort by value, you must be in Excel. Click on the last value in the column. Then go to the $^{Z}{}_{A}\downarrow$ key on the grey menu above. This will allow you to sort any value at any time

1b.) Is there any correlation between the position and the TS %? Have students make a scatter plot by hand or on the TI-83 calculator.

Answer: No, not really. The only correlation is that centers (5) are the two lowest TS.

2a.) Have students sort the players by FG%.

Answer:

Name	*FG%*
Shaquille O'Neal (5)	57.8%
Tim Duncan (4/5)	54.9%
Charles Barkley (4)	54.4%
Wilt Chamberlin (5)	54.1%
Magic Johnson (1/2/3)	52.1%
Michael Jordan (2/3)	50.5%
Larry Bird (3/4)	49.6%
Reggie Miller (2)	48.5%
Scottie Pippen (3/4)	48.3%
Grant Hill (3)	47.1%
Allen Iverson (1/2)	43.8%

b.) Is there any correlation between the position and the FG%? If yes, why? Have students make a scatter plot on the TI-83 calculator using position on the x-axis and FG% on the y-axis.
Answer: Yes, the players that play closer to the basket have a higher shooting % from the floor. The closer to the basket, the easier it is to make the shot.

3a.) Have the students sort the players by their FT%.

Answer:

Name	*FT%*
Larry Bird (3/4)	88.6%
Reggie Miller (2)	87.7%
Magic Johnson (1/2/3)	84.8%
Michael Jordan (2/3)	83.8%
Charles Barkley (4)	73.6%
Grant Hill (3)	73.4%
Allen Iverson (1/2)	71.5%
Scottie Pippen (3/4)	69.3%
Tim Duncan (4/5)	66.2%
Shaquille O'Neal (5)	53.5%
Wilt Chamberlin (5)	51.1%

b.) Is there any relationship between a player's FT% and their position?
Answer: Yes, the players that practice shooting from farther away from the basket generally perform better from the free throw line. I believe that this is an important statistic because it compares players shooting from the same point on the floor under the same circumstances. It is the closest thing to a controlled experiment that you can get in a sporting event.

4a.) Have students sort the players by their (Points Per Game) PPG. Have students make a scatter plot by hand or on the TI-83 calculator.

Answer:

Name	*PPG*
Michael Jordan (2/3)	31.5
Wilt Chamberlin (5)	30.1
Shaquille O'Neal (5)	27.2
Larry Bird (3/4)	24.3
Allen Iverson (1/2)	22.7
Charles Barkley (4)	22.5
Tim Duncan (4/5)	21.1
Grant Hill (3)	20.7
Magic Johnson (1/2/3)	19.7
Reggie Miller (2)	19.7
Scottie Pippen (3/4)	18.0

b.) Is there any relationship between a player's position and their PPG?
Answer: No, not in a direct sense, but in a more general sense. The data given here is taken from exceptional group of players who do not represent a cross-section of the players. Generally, players who are closer to the basket score more points, but Jordan, considered to be the best scorer of all time was a shooting guard.

Once again, refer to The Quarterback Rating sheet for further statistical analysis ideas. For example, do a full statistical analysis (boxplots, t-tests, etc.) comparing Jordan's PPG year-by-year to Chamberlain 's PPG. Have students make a scatter plot on the TI-83 calculator.